Islamic University of Gaza
Hydraulics (ECIV 3322)
Second Semester (2014-2015)
First Midterm Exam

Instructors:
Dr. KHALIL ALASTAL
Eng. AHMED AL-AGHA
Eng. RUBA AWAD
Allowable Time: 1 hr 15 min

15/15

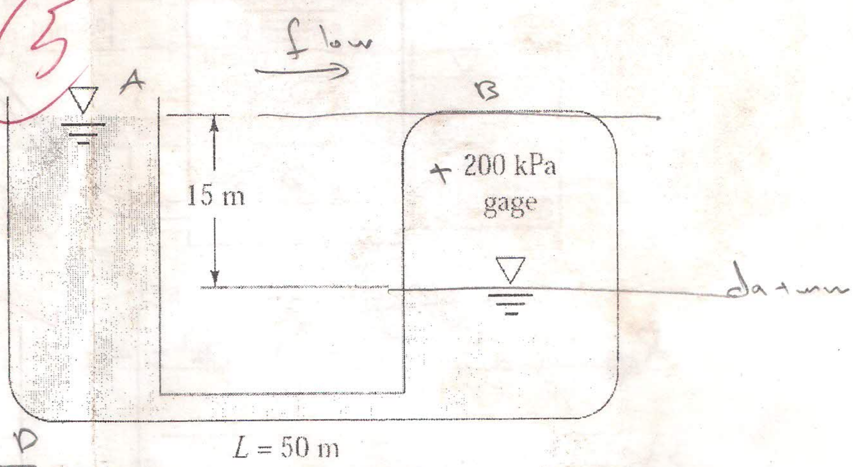
Student Name: ______

Question 1: (5 Points)

5

In the shown figure , the connecting pipe is commercial steel 6 cm in diameter having a roughness height of 0.045mm. **Determine** the direction of flow, and then **calculate** the flow rate. The fluid is water ($\mu = 1 \times 10^{-3}$ kg/m.s)

Neglect Minor losses.



$D = 0.06$ m

$\varepsilon = 0.045$

$\mu = 1 \times 10^{-3}$

$L = 50$

$Th_A = Th_B + h_L$

suppose flow from A to B

$15 = 0 + 0 + \frac{200 \times 10^3}{9810} + f \frac{50}{0.06} \frac{v^2}{2g}$

$15 = 20.38 + 42.51 f v^2$

$42.51 f v^2 = -5.38 \Rightarrow$ flow B→A

$\frac{\varepsilon}{D} = \frac{0.045}{60} = 7.5 \times 10^{-4}$

suppose $f = 0.02$

$v = 2.51$ m/s

$Re = \frac{1000 \times 2.51 \times 0.06}{10^{-3}} = 1.5 \times 10^5$

$f_{update} = 0.021$

$v = 2.45$ m/s

$Re = \frac{1000 \times 2.45 \times 0.06}{10^{-3}} = 1.47 \times 10^5$

$f_{update} = 0.021$

iteration end

$v = 2.45$ m/s

$Q = \frac{2.45 \times 0.06^2 \times 3.14}{4} = 6.93 \times 10^{-3}$ m³/s

flow from B → A

Excellent 4/4

Question 2 (4 Points)

In the shown figure, if the length of the pipe between reservoir **A** and point **B** is 180 m and the absolute pressure at point **B** is 7.3 mwc. **Calculate** the minor loss coefficient (K) of the valve at point C.

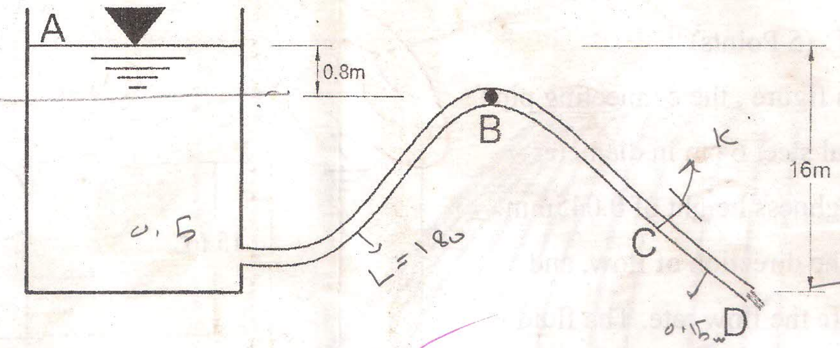
Given data:

The entrance is sharp edged.

Total length of pipe (L= 730 m), Pipe diameter (d = 150mm), the friction factor (f= 0.02).

abs = 7.3

$7.3 = 10.3 + P_a$



P_B gage= 7.3 − 10.3 = −3

D = 0.15 m

f = 0.02

$Th_A = Th_B + h_f + h_m$

$0.8 = -3 + 0 + \frac{v^2}{2g} + \frac{0.02 \times 180}{0.15}\frac{v^2}{2g} + 0.5\frac{v^2}{2g}$

$3.8 = 25.5\frac{v^2}{2g}$

$v = 1.71$ m/s

$Th_A = Th_D + h_f + h_m$

$16 = 0 + 0 + \frac{1.71^2}{2g} + \frac{0.02 \times 730 \times 1.71^2}{0.15 \times 2 \times g} + 0.5\frac{1.71^2}{2g} + k\frac{1.71^2}{2g}$

$16 = (98.8 + k)\frac{1.71^2}{2g}$

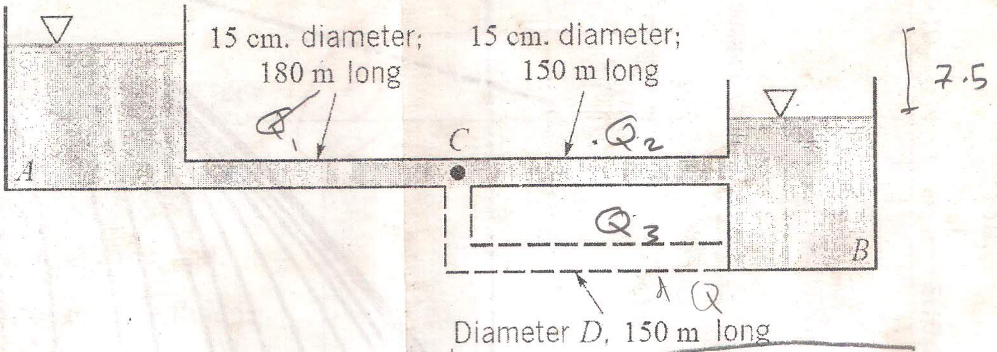
$98.8 + k = 107.24$

$k = 8.44$

6

Question 3 (6 Points)

The flow rate between tank *A* and tank *B* shown in the figure below is to be increased by 30% (i.e., from Q to 1.30Q) by the addition of a second pipe in parallel (indicated by the dotted lines) running from node *C* to tank *B*. If the elevation of the free surface in tank *A* is 7.5m above that in tank *B*, **determine** the diameter, *D*, of this new pipe. Neglect minor losses and assume that the friction factor for each pipe is 0.02.



$f = 0.02$

$D = 0.15$

$L = 180 + 150 = 330$ m

$Th_A = Th_B + h_L$

$7.5 = 0 + \frac{0.02 \times 330}{0.15} \frac{v^2}{2 \times 9.8}$

$v = 1.82$ m/s

$Q = 1.82 \times \frac{0.15^2}{4} \times 3.14 = 0.032$ m³/s

$Q_{new} = 0.032 \times 1.3 = 0.0416$ m³/s

$Th_A = Th_B + h_{L_1}$

$7.5 = 0 + \frac{8 \times 0.02 \times 180 \times 0.0416^2}{3.14^2 \times 0.15^5 \times 9.8} + \frac{8 \times 0.02 \times 150 \times Q_2^2}{3.14^2 \times 0.15^5 \times 9.8}$

$Q_2 = \sqrt{\frac{7.5 - 6.79}{3270.91}}$

$= 0.0147$ m³/s

$Q_1 = Q_2 + Q_3$

$0.0416 = 0.0147 + Q_3$

$Q_3 = 0.0269$ m³/s

$h_{L_2} = h_{L_3}$

$\frac{8 \times 0.02 \times 150 \times 0.0147^2}{3.14^2 \times 0.15^5 \times 9.8} = \frac{8 \times 0.02 \times 150 \times 0.0269^2}{3.14^2 \times D^5 \times 9.8}$

$D = 0.189$ m